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# Noise Exposure Summary And Comparitive Analyses

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**Facility Maintenance Worker  
Noise Exposure Assessment  
Summary  
And  
Comparative Analysis**

**Submitted by**

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**Submitted as a Draft Cap Stone in Partial Fulfillment of the Requirements  
For the  
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**And**

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## **I Introduction / Summary of Findings / Background**

### ***Introduction***

This paper summarizes and compares facility Operations and Maintenance (O&M) noise Dosimetry data to industry wide construction data. Dosimetry data has been compiled from a noise exposure assessment at a DOE national research facility Maintenance, Utilities, and Service Department (MUSD). This facility is the Lawrence Livermore National Laboratory (LLNL). The laboratory consists of ten O&M craft and trade shops responsible for a fifty year old infrastructure including over 300 buildings, and a worker population of approximately 7,000. The facility includes an extensive variety of noise generating activities throughout a one square mile site.

## **II Summary of Findings**

Seventy-nine Dosimetry assessments were completed within LLNL's Maintenance, Utilities, and Service Department including 19 craft and trade Similar Exposure Groups (SEGs). The assessments represented normal O&M operations similar to construction activities. The range of Dosimetry values was 71.5 to 94.6 dB(A). 21.5% of the values exceeded the ACGIH TLV of 85 dB(A).

Those MUSD SEGs subject to noise exposures in excess of 85 dB(A) were:

- |                               |                        |
|-------------------------------|------------------------|
| 1. Carpenters                 | 4. Jack Hammering      |
| 2. Demolition Workers         | 5. Landscaping, and    |
| 3. Heavy Equipment Operations | 6. Machine Maintenance |

None of the SEGs were found to have been exposed to an impulse noise level of 140 dB(A).

### ***Comparative Analysis***

Overall LLNL MUSD Dosimetry values appear to be similar to recent Construction Industry exposure data including specific SEGs such as, Carpenters, Electricians, Equipment Operators, and Sheet Metal workers as shown in Table 2, Comparative Noise Dosimetry Summary.

### ***Background***

Every year, approximately 30 million people in the United States are occupationally exposed to hazardous noise. Over half a million US Construction and Maintenance workers are exposed to hazardous levels of noise similar to that discussed in recent occupational health and safety literature<sup>1</sup>. The reduction of hazardous noise exposures can be difficult when dealing with transient work forces, multiple noise sources, and an OSHA regulatory environment that falls short of encouraging hearing loss prevention to the extent needed. For example, Timothy Rink, PhD, of the National Hearing Conservation Association (NHCA) in a letter dated March 16, 2011 asserts the following:

The United States currently lags behind many industrialized nations in the implementation of effective noise controls. There appears to be a misconception that 29 CFR 1910.95 provides reasonable intervention to adequately protect noise exposed workers. In fact, these very interventions are based upon dated and often discredited methods for assessing the risk of permanent hearing damage from exposure to noxious levels of noise on the job.<sup>2</sup>

Facilities covered by the general industry noise standard are required to institute Hearing Conservation Programs (HCPs) to prevent noise-induced hearing loss (NIHL) if the 8 hour time weighted average noise levels are at or above 85 dB(A). However, the construction industry, as noted above, has historically lagged behind the General Industry requirements to implement Hearing Conservation Programs (HCPs) despite excessive noise exposures<sup>3</sup>.

### III Noise Dosimetry Assessment Approach

#### 1. Introduction

This study design has been prepared in accordance with the following protocols:

- U.S. Department of Labor, Occupational Safety and Health Administration, OSHA Technical Manual, Chapter 5, Noise and Hearing Conservation, TED 01-00-015 [TED 1-0.15A] <sup>4</sup>, and
- Environmental Protection Agency, *Guidance for Quality Assurance Project Plans*, EPA QA/G-5<sup>5</sup>.

The purpose of this assessment approach is to provide a clear understanding of the data quality objectives, sampling strategy, analytical methods and data analysis methods for the project.

#### 2. Problem Definition

LLNL'S Health Services Department has identified a number of Standard Threshold Shifts (STS) amongst MUSD employees. In addition, a note has been made indicating a need to more thoroughly assess noise exposure data for the MUSD similar exposure groups (SEGs).

Data has been collected to answer the following study questions:

- a) To what noise levels are MUSD employees exposed relative to shop activities and noise sources?
- b) Are MUSD employees exposed to noise levels greater than the 8-hour ACGIH TLV exposure limit of 85 dB(A)?
- c) Are MUSD employees exposed to noise equal to or greater than an instantaneous (peak) level of 140 dB(C)?
- d) Are the noise exposures to MUSD employee's variable from day-to-day?

#### 3. Quality Objectives and Criteria for Measurement Data

The data quality objective (DQO) process as summarized in Table 1, was used as a systematic process for planning data collection activities to ensure that the right type, quality, and quantity of data are collected to satisfy users' needs. The system provides quantitative and qualitative measures that help determine whether the data is scientifically defensible for use in drawing conclusions to answer the study questions<sup>6</sup>.

#### *Measurement Performance Criteria*

The following data quality indicators have been used to determine whether the data collected for this project meet the DQO's:

*Precision* – A measure of agreement among repeated measures of the same property under identical, or substantially similar conditions. This was assured by use of instrumentation of the same make and model, and identical calibration processes for both the Type II Sound Level Meter (SLM) and the Quest NoisePro dosimeters.

*Accuracy* – A measure of overall agreement of a measurement to a known value. According to the calibration procedure, the noise dosimeters are calibrated to the precision of  $\pm 0.8$  dB (Accuracy of Quest NoisePro<sup>TM</sup> ND:  $\pm 0.5$  dB, plus accuracy of QC-20-  $\pm 0.3$  dB) and the sound level meters are calibrated to the precision of  $\pm 0.8$  dB.

*Realism* – The extent to which the measured data represents the actual worker activity normally conducted. Verification of normal activities planned for Dosimetry was conducted by observing routine worker activities, and interviewing workers.

**Table 1: Summary of Data Quality Objective Process**

1. State the Problem	The Noise SME has identified a problem that there have been a number of standard threshold shifts (STS) amongst the MUSD employees.
2. Identify the Decision	Are employees experiencing noise TWAs greater than the ACGIH TLV exposure limit for an 8-hour shift?
3. Identify inputs to the Decision	<ol style="list-style-type: none"><li>1. Use of 3M Noise Indicator during various operations to determine hazardous situations.</li><li>2. Use sound level meters to identify sources of contributing noise.</li><li>3. Implement noise Dosimetry to assess worker exposures for different work tasks performed by various MUSD shops.</li></ol>
4. Define the Study Boundaries	The dosimetry assessment has been limited to the work performed by employees of MUSD. Dosimetry data will be compared to Construction wide data.
5. Develop a decision rule	
6. Specify Limit of Decision Errors	Employee noise exposure is at or above a Time Weighted Average of 85 dB(A).
7. Optimize the Design for Obtaining Data	<p>The probability of making an incorrect decision has been limited to 5%.</p> <p>Noise monitoring will only be performed for work tasks of a high noise level hazard, as indicated by the 3M Noise indicators.</p>

#### **4. Personnel Training and Qualifications**

All personnel performing data collection were trained in the use of the SLMs and dosimeters. At the beginning of the project, all field personnel received refresher training on the procedures and processes defined in this plan. If new field personnel were introduced to the project, they received similar training before they were allowed to collect samples unsupervised.

## IV .Methods

### 3.1 Sampling Strategy and Methods Requirements

#### 3.1.1 Pre-Planning

Prior to sample data collection, MUSD work orders describing field activities were organized into appropriate tasks with associated documentation of hazard evaluations. Industrial Hygienists utilized O&M work orders to determine field activities, location of sampling, and sample maps for data collection. Industrial Hygienists attended MUSD Shops' Plan of the Day (POD) meetings to build rapport with MUSD personnel, and receive briefings of daily scope of work.

#### 3.1.2 Instrumentation

All sampling equipment were inspected and tested before use in the field. The equipment was re-inspected after each use. Any damaged or malfunctioning equipment was tagged and removed from service until it was properly repaired and new measurements were obtained. Equipment is routinely inspected and calibrated by its manufacturer annually.

*Noise indicator* - used as a screening device to determine which MUSD activities may require additional monitoring with a noise dosimeter. The noise indicator is manufactured by 3M<sup>TM</sup> and does not require calibration. The indicator will blink green when noise is below the LLNL exposure limit of 85 decibels and blink red above the exposure limit ( $\pm 3$  dB(A)). The Noise Indicator provided easy, durable noise level detection by alerting users to potentially dangerous noise levels and helping identify areas where hearing protection may need to be worn.

*Sound level meter* – a Quest Model 2200 Sound Level Meter (SLM) was used to accompany the noise indicator to spot-check noise levels while observing various work tasks. The sound level meter was calibrated at the beginning and end of each shift in accordance with the OSHA Technical Manual (OTM). A secondary standard calibration device was used.

*Noise dosimeter* - Quest Technologies Noise-Pro Dosimeters were used to determine employee noise dose over a full 8-hour work shift. The noise dosimeter was calibrated at the beginning and end of each shift in accordance with the OTM. A primary standard calibration device was used to verify calibration.

*Octave band analyzer (OBA, QC10 Model 2700)* – was made available to help determine the adequacy of various types of frequency-dependent noise controls. The OBA was utilized under specific circumstances when measuring the amount of attenuation (how much sound is weakened) for a specific task. The OBA was calibrated to a primary standard at the beginning and end of each shift in accordance with the OTM.

### **3.1.3 Sampling**

Field forms were used by the field Industrial Hygienist throughout the sampling process (Appendix 2, 605 – IH Noise Dosimetry Record, and 606 IH Sound Level / Octave Band Analysis Record). These forms were used during calibrations, and specific field notations taken throughout sampling per LLNL's Industrial Hygiene Field Operations Manual. A water-proof pen was used for appropriate notations during sampling and a tape measure was carried to appropriately map out high decibel areas and identify the 85 dB(A) line, or noise impact radius, of each piece of loud equipment or tool. This was done in order to appropriately assess noise severities with a sound level meter at varying distances.

Personal Protective Equipment (PPE) was required by IH field personnel due to the varying work locations of the MUSD personnel. Required minimum PPE included: safety shoes, safety glasses with side shields, and hearing protection. A hard hat was worn according to MUSD requirements for specific work areas/tasks.

### **3.1.4 Data Input/Documentation**

Personal data results were entered into an industrial hygiene database by Similar Exposure Groups (SEGs) in terms of equivalent level ( $L_{eq}$ ), average level ( $L_{avg}$ ), peak level ( $L_{pk}$ ), percent dose (%Dose); and control measures). Area measurements were maintained in a spreadsheet to document quality and progress of work. Photographs, diagrams, floor plans, etc. were used in conjunction with field forms to document noise levels.

### **3.1.5 Sampling System Failure**

If an event occurred that resulted in equipment failure, delays sample processing, affects holding times, delays work or impacts data quality, the event was documented.

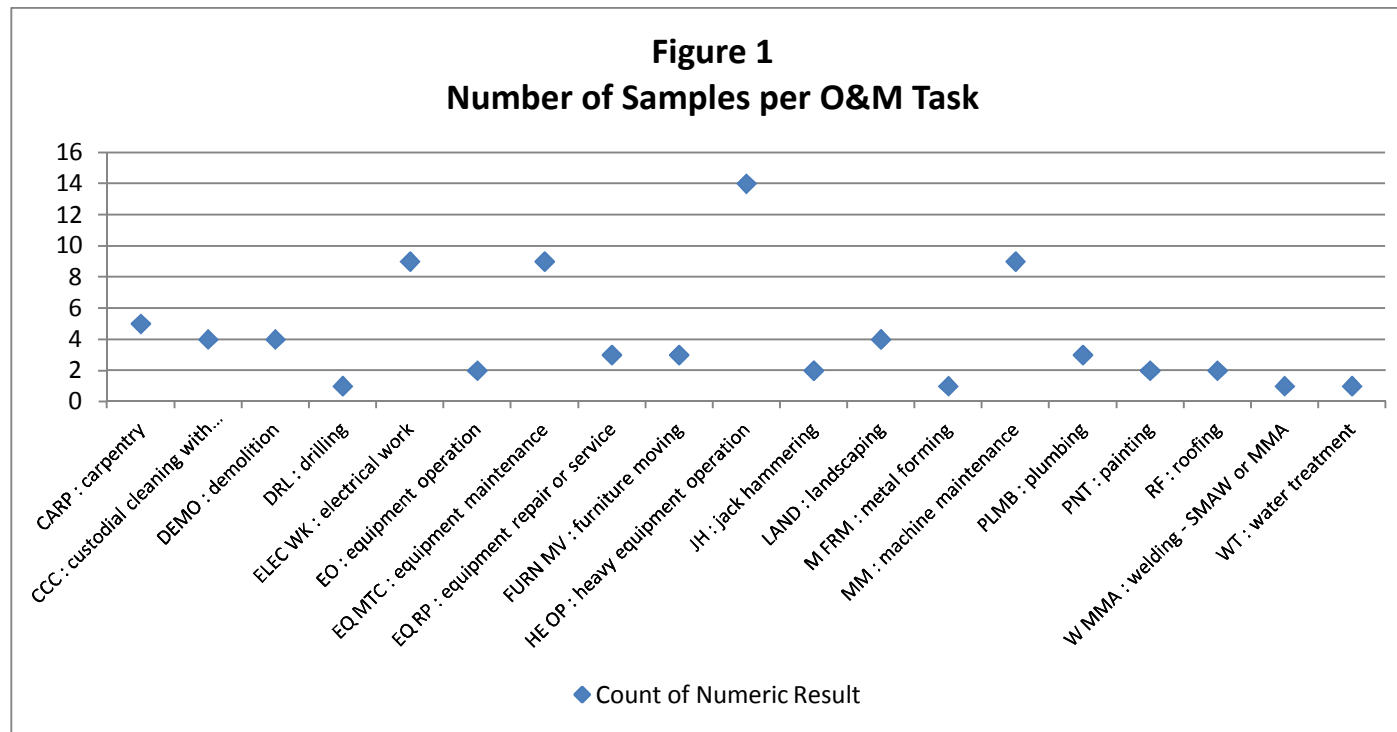
### **3.1.6 Instrument/Equipment Testing, Inspection and Maintenance Requirements**

All instrument and equipment testing was performed in accordance with the current LLNL Industrial Hygiene Instrumentation Calibration Procedures.

## V. Results Discussion

### *LLNL MUSD Dosimetry*

Seventy nine MUSD Dosimetry assessments were conducted over a one year period representing worker noise exposures during nineteen activities related to facility operation and maintenance (O&M) as shown in Figure 1 below. All of the MUSD Dosimetry data are tabulated in Attachment 1.



The Dosimetry data ranged from a minimum of 71.5 to a maximum of 94.6 dB(A) as summarized in Figure 2 and 3. Twenty-one point five (21.5) percent of the data exceeded the ACGIH TLV of 85 dB(A) as shown in Section 3, Dosimetry Descriptive Statistics.

**Figure 2**  
**LLNL Dosimetry Data**  
**(Highest to Lowest)**

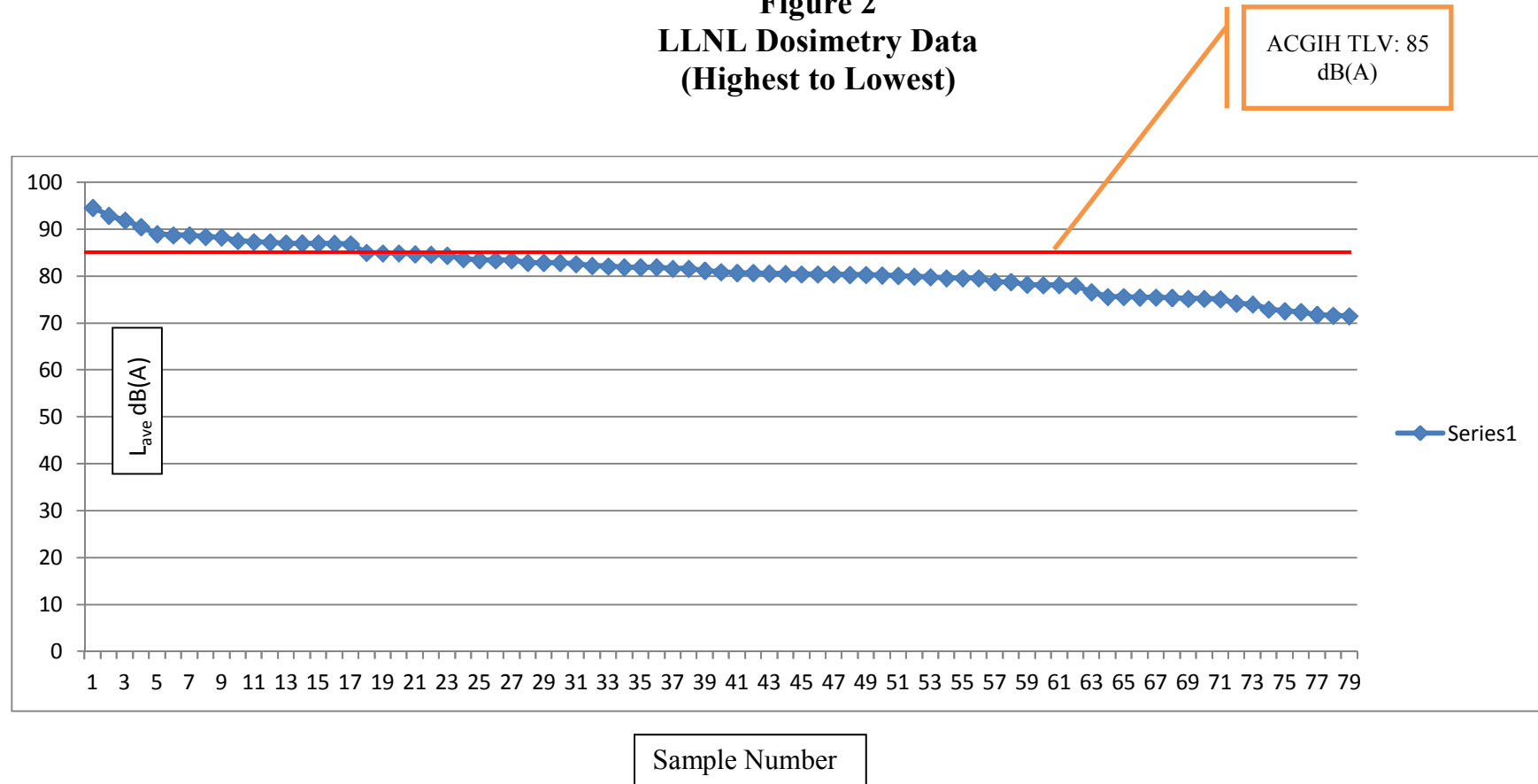
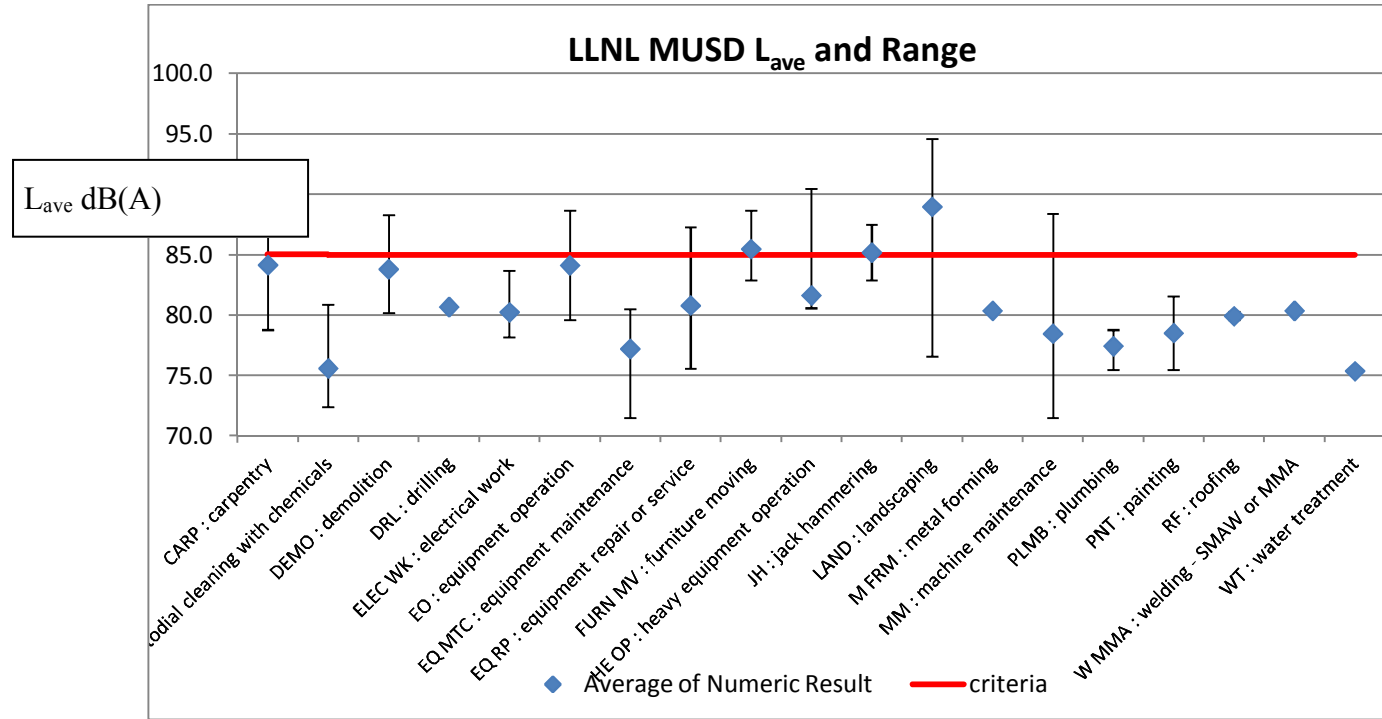


Figure 3



**Notes:**

- The Figure 2 criteria represents LLNL's adherence to ACGIH's TLV of 85 dB(A).
- $L_{ave}$  and range values without regard to Hearing Protection Devices (HPDs).

MUSD Shop activities shown to generate noise resulting in worker exposures in excess of 85 dB(A) are:

1. Machine Maintenance
2. Heavy Equipment Operation
3. Equipment Repair / Service
4. Carpentry, and
5. Landscaping
6. Demolition
7. Jack Hammering

### ***Construction Industry Comparative Analysis***

As previously noted, the intent of this paper is to compare the findings of this Dosimetry assessment to data representative of the Construction Industry. Recent findings published by the Annals of Occupational Hygiene and the American Industrial Hygiene Association (AIHA) are available, informative, and relevant to construction Dosimetry similar to that conducted at LLNL<sup>7,8</sup>. The Annals of Occupational Hygiene findings follow construction worker cohort members from 1999 to 2009 during which, Dosimetry data were obtained including trade-mean noise level averages ( $L_{ave}$ ). Notable similarities between four trades of the cohort study and the LLNL data are shown in Table 2, Comparative Noise Dosimetry Summary. A statistical analysis of the values using the Wilcoxon Rank-Sum Test yields a statistic (W), providing a corresponding “p” value and a 95% confidence level accepting a null hypothesis that the values are similar as shown in Attachment 3, Dosimetry Statistics.

**Table 2  
Comparative Noise Dosimetry Summary**

<b>Trade SEG</b>	<b>LLNL MUSD (<math>L_{ave}</math>)</b>	<b>10 Year Longitudinal Cohort Study<sup>10</sup> (<math>L_{ave}</math>)</b>	<b>Occupational Assessment of Noise Exposures<sup>11</sup> (<math>L_{ave}</math>)</b>
<b>Carpenter</b>	84.2	83.7	80.3
<b>Electrician</b>	80.3	80.4	--
<b>Operating Engineer</b>	84.2	84.1	84
<b>Sheet Metal</b>	80.4	80.5	--
<b>Construction / # of Samples (n)</b>	81.4 / 79	82.6 / 1310	82.5 / 338
<b>% Overall Construction Trades &gt; 85 dB(A)</b>	21.3	33.2	39.7

The findings of the AIHA Journal identify two (Carpenter and Operating Engineer) mean trade Dosimetry values also comparable to the LLNL MUSD assessment also shown in Table 2

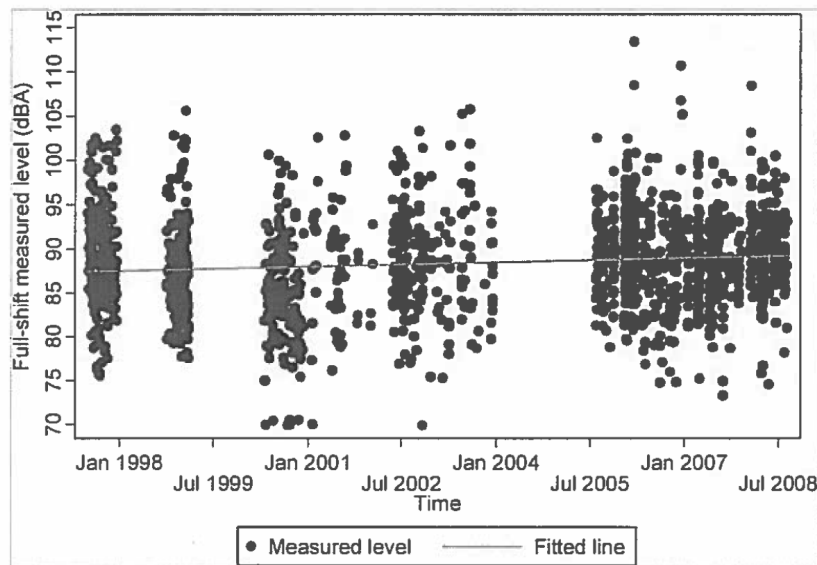
## VI. Conclusions / Recommendations

LLNL's MUSD Dosimetry assessment findings have documented worker exposures to hazardous levels (i.e. > ACGIH TLV of 85 dB(A)) of noise without regard to Hearing Protection Devices (HPDs). In addition, Dosimetry values are in general agreement with the Construction Industry as observed in the noted Longitudinal Cohort Study<sup>7</sup>, in particular, selected SEGs. Noise sources common to the excursions are those including hydraulics, pneumatics, and other energy intensive processes such as:

- Chop Saws
- Sheet Metal Shears
- Noisy tool
- Jack Hammers
- Circular Concrete Saws
- Table Saws
- Planers
- Mowers
- Stump Grinders
- Heavy Equipment

A notable observation from the Cohort Study illustrates minimal changes in full shift measured noise exposure over a 10 year period as shown in the figure below. This observation may be attributed to minimal improvements in noise source design within the industry.

**Fig. 1.**



Full-shift dosimetry measurements over time ( $n = 1310$  measurements).

The Figure 1 above is presented with permission<sup>7</sup>.

The resultant worker exposures and presumed NIHL are likely to be a combination of:

- A lack of centralized Dosimetry data within the industry;
- A lack of centralized Medical Surveillance (audiometry);
- A need to improve worker training;
- A need to improve HPD compliance, and
- The need to develop and sustain a Hearing Conservation Program (HCP).

In a paper presented by Alice H. Suter<sup>1</sup> the above issues are partially addressed and recommendations are made to utilize a credit card sized optical card storing useful information such as training and audiology available to transient Construction workers and their employers.

## **VII            Table of Acronyms**

O&M	Operations and Maintenance
DOE	Department of Energy
OSHA	Occupational Safety and Health Administration
NHCA	National Hearing Conservation Association
CFR	Code of Federal Regulations
dB(A)	decibels (A Scale)
HCP	Hearing Conservation Program
NIHL	Noise Induced Hearing Loss
FOM	Field Operations Manual
STS	Standard Threshold Shift
ACGIH	American Conference of Governmental Industrial Hygienists
TLV	Threshold Limit Value
dB	Decibels
EPA	Environmental Protection Agency
POD	Plan of the Day
SME	Subject Matter Expert
SEG	Similar Exposure Group
OTM	OSHA Technical Manual
OBA	Octave Band Analyzer

## **Attachment 1**

### **MUSD Dosimetry data**

	Operation Facility	Sample ID	Process Type	Task	Numeric Result
1	B515	1005310	MTC	LAND : landscaping	94.6
2	B515	1005320	MTC	LAND : landscaping	92.9
3	B515	1005330	MTC	LAND : landscaping	91.9
4	B418	1002540	MTC	HE OP : heavy equipment operation	90.5
5	B418	1002550	MTC	HE OP : heavy equipment operation	89
6	B418	1002881	MTC	EO : equipment operation	88.7
7	B418	1002560	MTC	FURN MV : furniture moving	88.7
8	B519-R116	1004520	MTC	MM : machine maintenance	88.4
9	B418	1002560	MTC	DEMO : demolition	88.3
10	B418	1002520	MTC	JH : jack hammering	87.5
11	B511	1004360	MTC	EQ RP : equipment repair or service	87.3
12	B418	1003270	MTC	HE OP : heavy equipment operation	87.2
13	B511	1001940	MTC	CARP : carpentry	87
14	B511	1002270	MTC	CARP : carpentry	87
15	B418	1002870	MTC	HE OP : heavy equipment operation	87
16	B519	1004442	MTC	HE OP : heavy equipment operation	86.9
17	B418	1002271	MTC	HE OP : heavy equipment operation	86.8
18	B418	1002880	MTC	HE OP : heavy equipment operation	85
19	B418	1002570	MTC	DEMO : demolition	84.9
20	B418	1002570	MTC	FURN MV : furniture moving	84.9
21	B519-R116	1004456	MTC	MM : machine maintenance	84.7
22	B511	1001970	MTC	CARP : carpentry	84.6
23	B873	1004190	MTC	HE OP : heavy equipment operation	84.4
24	B511	1004641	MTC	ELEC WK : electrical work	83.7
25	B511	1002060	MTC	CARP : carpentry	83.5
26	B511	1004644	MTC	ELEC WK : electrical work	83.4
27	B418	1003260	MTC	HE OP : heavy equipment operation	83.4
28	B418	1002571	MTC	FURN MV : furniture moving	82.9
29	B418	1002571	MTC	HE OP : heavy equipment operation	82.9
30	B418	1002571	MTC	JH : jack hammering	82.9

**Notes**

All units Average noise level, Decibels, A weighting scale  $L_{ave}$  (dB(A))

     Data available for comparison to Construction Industry Dosimetry

	Operation Facility	Sample ID	Process Type	Task	Numeric Result
31	B418	1003152	MTC	HE OP : heavy equipment operation	82.6
32	B418	1003160	MTC	HE OP : heavy equipment operation	82.2
33	B519-R116	1004454	MTC	MM : machine maintenance	82.1
34	B418	1002290	MTC	DEMO : demolition	81.9
35	B511	1004643	MTC	ELEC WK : electrical work	81.9
36	B519-R116	1004521	MTC	MM : machine maintenance	81.9
37	B517	1004772	MTC	ELEC WK : electrical work	81.6
38	B418	1002950	MTC	PNT : painting	81.6
39	B418	1002890	MTC	HE OP : heavy equipment operation	81.2
40	B511	1004562	MTC	CCC : custodial cleaning with chemicals	80.9
41	B511	1004270	C	DRL : drilling	80.7
42	B511	1004452	MTC	ELEC WK : electrical work	80.7
43	B519	1004440	MTC	HE OP : heavy equipment operation	80.6
44	B324	1006350	MTC	EQ MTC : equipment maintenance	80.5
45	B324	1005011	MTC	EQ MTC : equipment maintenance	80.4
46	B511	1004470	MTC	M FRM : metal forming	80.4
47	B511	1004470	MTC	W MMA : welding - SMAW or MMA	80.4
48	U291	1003310	MTC	EQ MTC : equipment maintenance	80.3
49	B511	1004130	MTC	RF : roofing	80.3
50	B418	1002307	MTC	DEMO : demolition	80.2
51	B324	1004972	MTC	EQ MTC : equipment maintenance	80.1
52	B517	1004770	MTC	ELEC WK : electrical work	79.9
53	B324	1005010	MTC	EQ MTC : equipment maintenance	79.8
54	B418	1002273	MTC	EO : equipment operation	79.6
55	B511	1004361	MTC	EQ RP : equipment repair or service	79.6
56	B511	1004120	MTC	RF : roofing	79.6
57	B511	1002260	MTC	CARP : carpentry	78.8
58	B511	1004350	MTC	PLMB : plumbing	78.8
59	B517	1004771	MTC	ELEC WK : electrical work	78.2

**Notes**

All units Average noise level, Decibels, A weighting scale  $L_{ave}$  (dB(A))

Data available for comparison to Construction Industry Dosimetry

	Operation Facility	Sample ID	Process Type	Task	Numeric Result
60	B511-R110	1004873	MTC	MM : machine maintenance	78.1
61	B511	1003901	MTC	PLMB : plumbing	78.1
62	B511	1004451	MTC	ELEC WK : electrical work	78
63	B515	1005311	MTC	LAND : landscaping	76.6
64	B511	1004262	C	EQ RP : equipment repair or service	75.6
65	B511	1004430	MTC	MM : machine maintenance	75.6
66	B511	1004351	MTC	PLMB : plumbing	75.5
67	B418	1001950	MTC	PNT : painting	75.5
68	U291	1003330	MTC	WT : water treatment	75.4
69	B511	1004560	MTC	CCC : custodial cleaning with chemicals	75.2
70	B324	1006290	MTC	EQ MTC : equipment maintenance	75.2
71	B511	1004453	MTC	ELEC WK : electrical work	75.1
72	B324	1004971	MTC	EQ MTC : equipment maintenance	74.2
73	B511	1004561	MTC	CCC : custodial cleaning with chemicals	74
74	B324	1004970	MTC	EQ MTC : equipment maintenance	72.9
75	B511-R110	1004871	MTC	MM : machine maintenance	72.6
76	B519	1004441	MTC	CCC : custodial cleaning with chemicals	72.4
77	B324	1005140	MTC	EQ MTC : equipment maintenance	71.8
78	B511	1004431	MTC	MM : machine maintenance	71.6
79	B511-R110	1004870	MTC	MM : machine maintenance	71.50
<b>Average:</b>					<b>81.43</b>

**Notes**

All units Average noise level, Decibels, A weighting scale  $L_{ave}$  (dB(A))

■ Data available for comparison to Construction Industry Dosimetry

## **Attachment 2**

### **Dosimetry Statistics**

# Industrial Hygiene Statistics

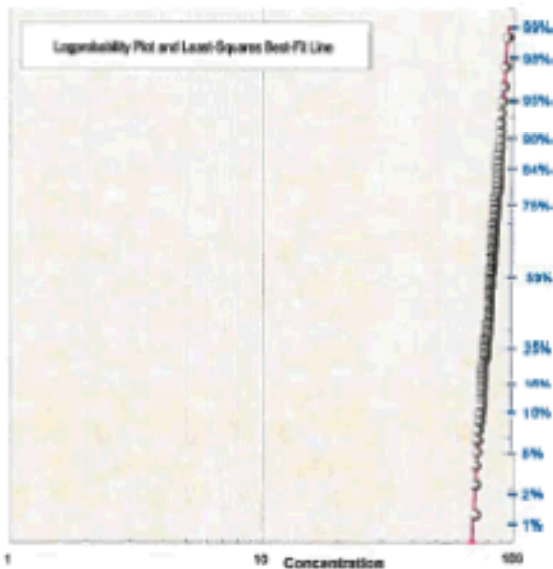
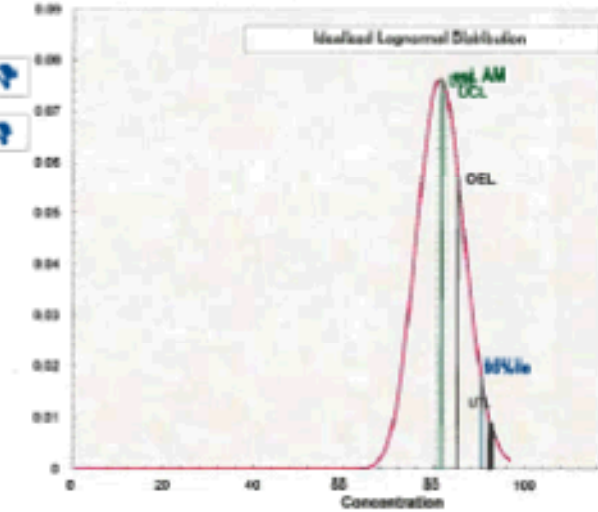
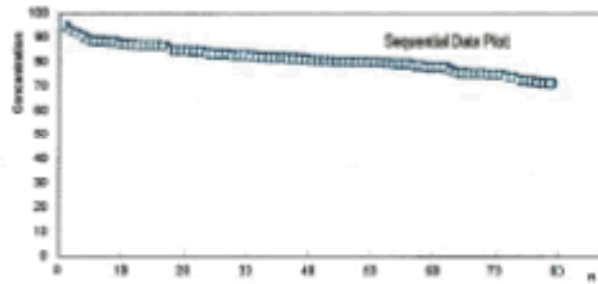
CEL
88
Sample data
94.5
92.9
91.9
90.5
88
88.7
88.7
88.4
88.5
87.5
87.5
87
87
87
86.9
86.9
86
85.9
84.9
84.7
84.6
84.4
83.7
83.5
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80.4
80.4
80.3
80.3
80.2
80.1
79.8
79.5
79.6
79.6
79.8
79.6
79.2
79.1
79.1
79
79.6
79.6
79.6
79.5
79.6
79.4
79.2
79.2

Descriptive statistics	
Number of samples (n)	79
Maximum (max)	94.5
Minimum (min)	71.5
Range	23.1
Mean	81.4
Median	80.9
Standard deviation (s)	5.23
Geometric mean	81.3
Geometric standard deviation	1.07
Percent above CEL	21.5%

Test for distribution fit	
W-test of log-transformed data	0.907
Lognormal ( $\alpha = 0.05$ ) ?	No
W-test of data	0.908
Normal ( $\alpha = 0.05$ ) ?	No

Lognormal parametric statistics	
Estimated Arithmetic Mean - AM est	81.400
UCL1.95% - Land's "Exact"	80.590
UCL1.95% - Land's "Exact"	82.400
50th Percentile	80.315
UTL95% 95%	82.5
Percent above OEL	24.2%
UCL1.95% 95%OEL	18.5
UCL1.95% 95%OEL	33.1

Normal parametric statistics	
Mean	81.4
UCL1.95% - 1 standard	80.448
UCL1.95% - 1 standard	82.415
50th Percentile - Z	80.610
UTL95% 95%	82
Percent above OEL	24.6%



**The Wilcoxon Rank-Sum Test (Two Independent Samples)**

	83.7	84.2
Observations:	4	4
Mean:	81.9	82.625
Median:	81.55	82.3
Standard Deviation:	1.783255	2.688711
<b>The Test Procedure</b>		
Hypothetical Mean Difference:	0	
Nb. of Tie Series:	7	
Average Nb. of Tie per Series:	1.142857	
Rank Sum:	36	
Rank Average:	4.5	
Test Statistic (W):	17.5	
Nominal Significance Level:	0.05	
Actual Signif. Lev.:	0.014286	
<b>Exact Procedure Two-Tailed Test</b>		
Critical Values:	10 and 26	
Decision Rule:	Reject H0 if W < 10, or W > 26	
Final Decision:	The Null Hypothesis Cannot be Rejected due to Insufficient Evidence in the Sample	
P-Value:	0.885714	

**INPUT DATA & RANKS**

	<b>Cohort</b>	<b>MUSD</b>	<b>RANKS</b>	
Carpenters	83.7	84.2	83.7	84.2
Electricians	80.4	80.3	2.5	1
Equipment Operation	84.1	84.2	6	7
Sheet Metal	80.5	80.4	4	2.5
Construction	82.6	81.43	5	8

## **Appendix 1**

### **Noise Dosimetry Record**

IH NOISE DOSIMETRY RECORD						Page ____ / ____
<b>Activity Location Information</b>						
Bldg/Room/Area		Area/Worker Supervisor Name and Extension		hVS Number	Date	
Activity: (operation description and sub-task, duration [per day], frequency [times per day and days per year], potential hazardous noise sources, ototoxic chemicals, etc.)						
Hearing Protection Used: (circle all that apply)		NRR of HPD		Current Noise Control(s):		
earplugs				Engineering		
earmuffs				Administrative		
double protection				non-HPD PPE		
Type of Monitoring and Method: (circle all that apply)		other				
personal sample						
area sample						
TWA						
STEL						
Peak						
<b>Sampling Equipment Information</b>						
Sample Number	Brand & Model			HC Equipment Number	Lab Calibration Date	
1						
2						
3						
4						
<b>Calibration Information</b>						
Sample Number	Pre-Survey Reading at 1000 Hz	Post-Survey Reading at 1000 Hz	Battery Check (Y/N)	Calibrator HC Number	Lab Calibration Date	
1						
2				Calibrator Brand & Model		
3						
4						
<b>Sample Location Information</b>						
Sample Number	Employee Name (last, first, middle initial) or Location Description			Employee Number (if applicable)	Job Title (if applicable)	
1						
2						
3						
4						
<b>Data Collected</b>						
Sample Number	Start	Stop	Time	Dosimeter		
				L-Avg / L-Eq	TWA	
1						
2						
3						
4						

Current LLNL (ACGIH) Standard: 85 dBA 8-hr TWA

Surveyor: \_\_\_\_\_ Title: \_\_\_\_\_ Date: \_\_\_\_\_

(Diagram, notes and analysis on back)

IHS Form No. 605, Rev. 10/01/07







## **VI. References**

- <sup>1</sup> Suter A. H. (2002). Construction Noise: Exposure, Effects, and the Potential for Remediation: A Review and Analysis. AIHA Journal 63:768–789
- <sup>2</sup> OSHA Docket Office. Feasible Noise Control. Constitution Avenue, NW, Washington, DC 20210: Docket No. OSHA-2010-0032 ,
- <sup>3</sup> OSHA Quick Takes, Section II: What standards limit and control noise exposure?, Construction Industry, Hearing Conservation Program
- <sup>4</sup> U.S. Department of Labor, Occupational Safety and Health Administration, OSHA Technical Manual, Chapter 5, Noise and Hearing Conservation
- <sup>5</sup> U.S. Environmental Protection Agency, EPA Guidance for Quality Assurance Project Plans. EPA QA/G-5
- <sup>6</sup> Guidance on Systematic Planning Using The Data Quality Objectives Process EPA QA/G4
- <sup>7</sup> Richard. L. Neitzel, Bert. Stover, and Noah. S. Seixas. Longitudinal Assessment of Noise Exposure in a Cohort of Construction Workers. Ann Occup Hyg. 2011 Oct, 55 (8): 906-916.
- <sup>8</sup> Richard L. Neitzel, Noah S. Seixas, Janice Camp, Michael Yost. An Assessment of Occupational Noise Exposures in Four Construction Trades. AIHA Journal (60). November/December 1999.

## **Acknowledgments**

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